



Distributed Energy Roadshow

April 23, 2003

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Topics

- Clemson University Central Utilities
- Industrial Sized Cogeneration
- Diesel RICE (Emergency/Peak-Shaving)
- Micro-Cogeneration
- Future of Cogeneration
 - » “Hey! That’s My Natural Gas You’re Burning”

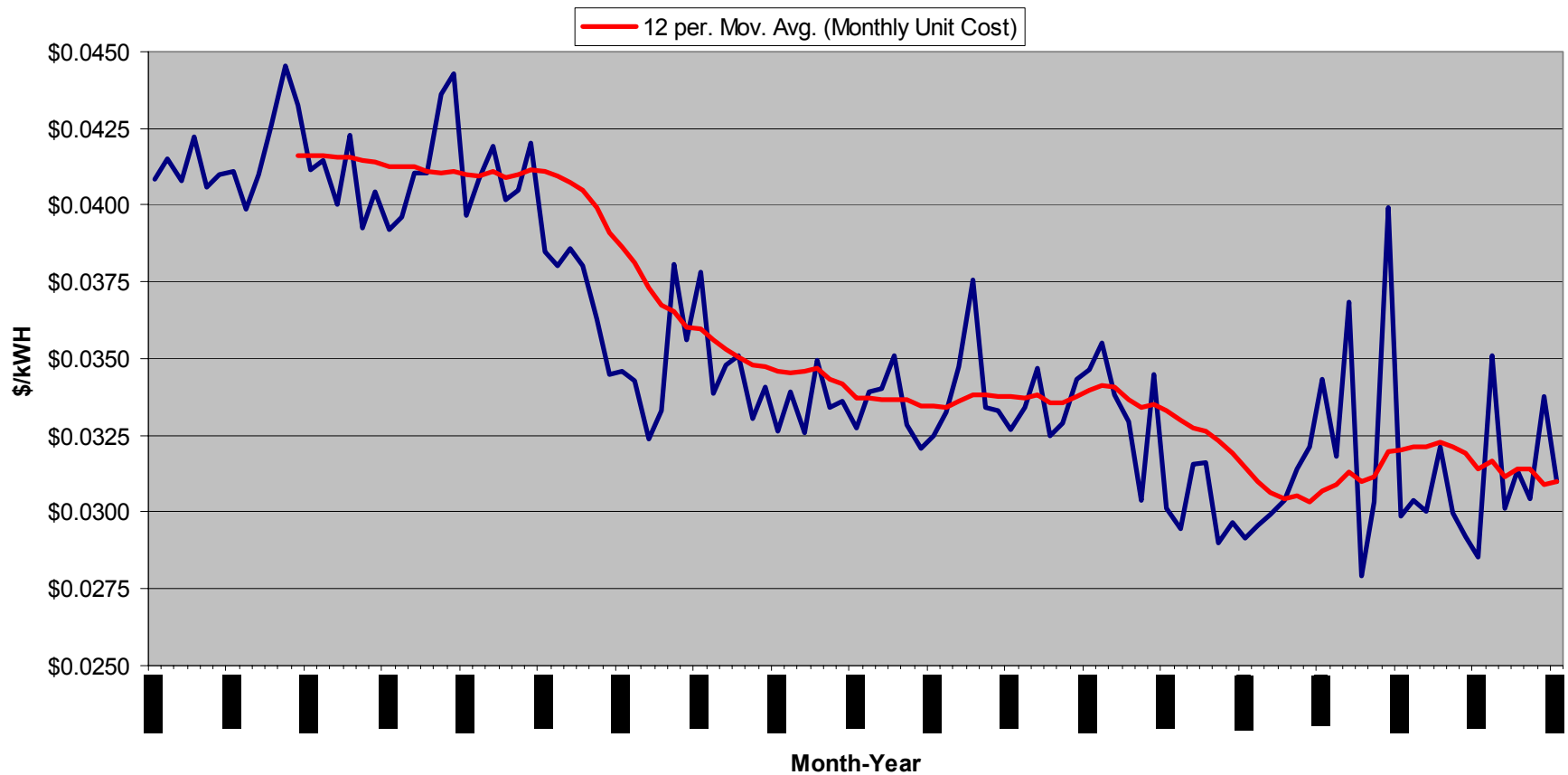
Central Utilities

Average Yearly Energy Consumption

- 120,000,000 kWH Electrical Consumption
 - » Supplied by Duke Power (Duke Energy Corp.)
 - » Peak Summer Demand - 21 MW
- 400,000,000 lbs. Steam Consumption
 - » Primary Fuels – Coal & Natural Gas
 - » Emergency Fuel - No. 2 Fuel Oil
- 425,000,000,000 BTU Chilled Water Consumption
 - » 5,400 Tons Electric Centrifugal, 1,000 Tons Absorption - CEF
 - » 2,250 Tons Electric Centrifugal - East Campus Plant

Central Utilities

Clemson University - Unit Electrical Cost



Distributed Generation

Existing Assets

- SOLAR Taurus 60 Gas Turbine (4800 kW)
- SOLAR Mercury 50 Gas Turbine (4200 kW)
- Caterpillar Diesel IC Engine (750 kW)
- Kohler Diesel IC Engine (650 kW)
- Caterpillar Diesel IC Engine (450 kW) (6/03)
- Caterpillar Diesel IC Engine (300 kW)
- Capstone Microturbine (30 kW)

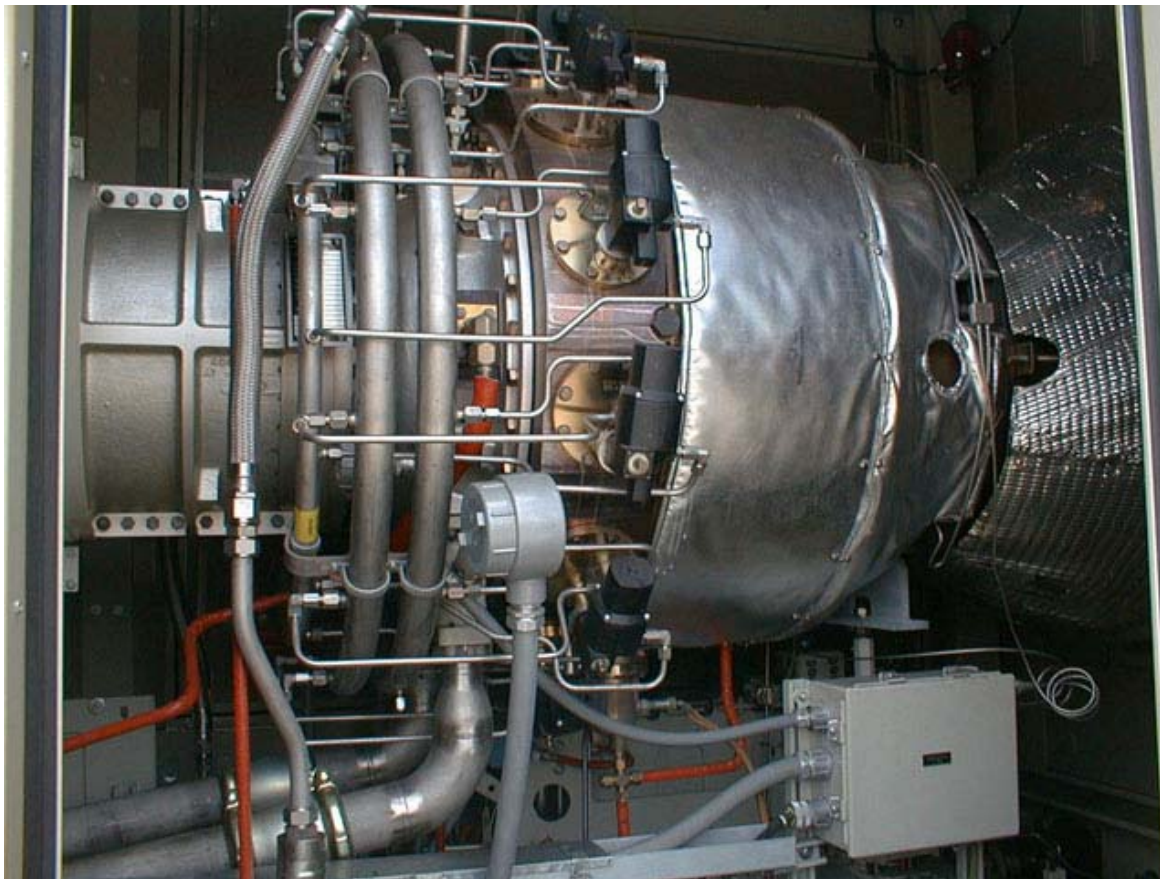
Distributed Generation - CHP

SOLAR Taurus 60 Gas Turbine Generator



Distributed Generation - CHP

SOLAR Taurus 60 Gas Turbine Generator



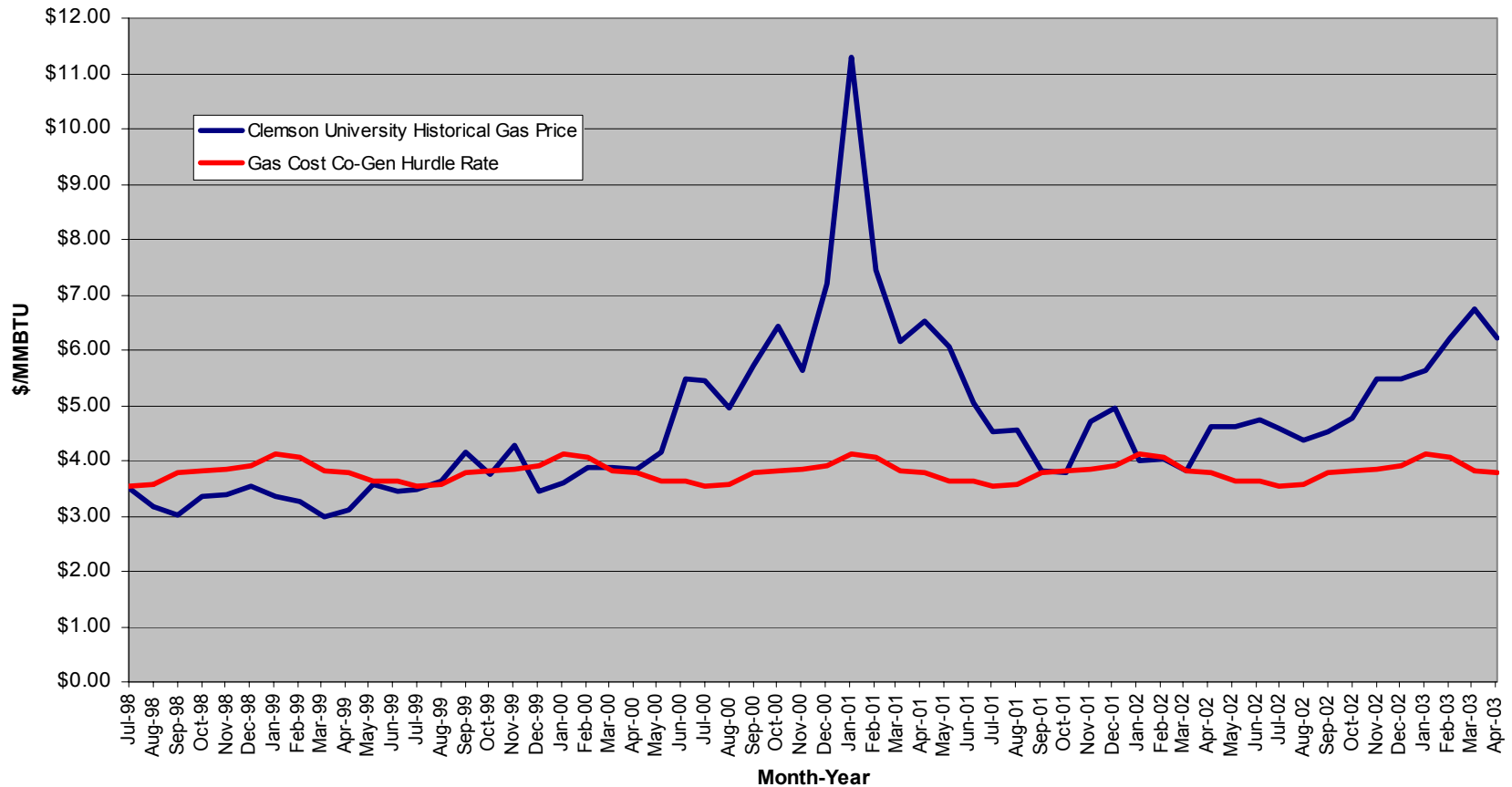
Distributed Generation - CHP

ERI Heat Recovery Boiler



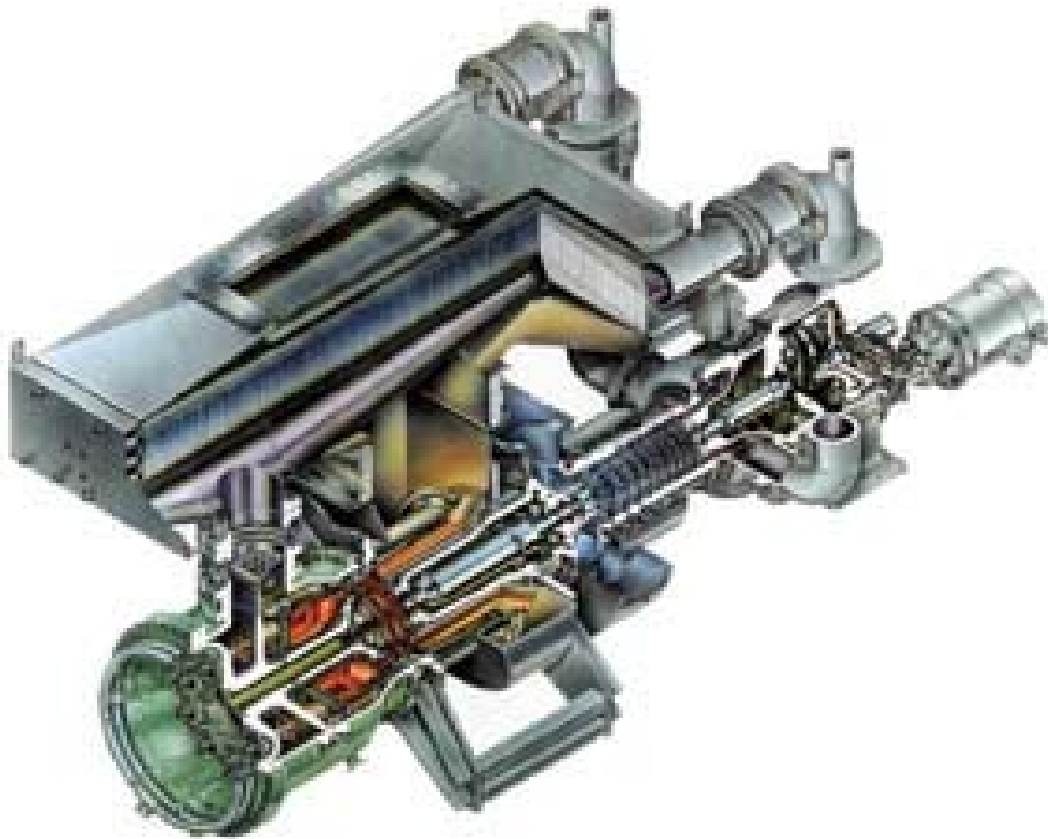
Distributed Generation - CHP

Taurus 60 CHP Economic Dispatch



Distributed Generation

SOLAR Mercury 50 Advanced Gas Turbine



Distributed Generation

SOLAR Mercury 50 Advanced Gas Turbine



Distributed Generation

CEF Emergency Generator

- 300 kW Diesel Generator to Start Taurus 60
- Original Design Uses Automatic Transfer Switches
- Full Capacity Paralleling Gear Upgrade Will Be Added for a Total Cost of \$70,000
 - » Estimated Savings of up to \$20,000 per Year
 - » Limited Runtime (< 80 hrs/yr.)
 - » Improved Testing, Maintenance, and Operation Due to Generation at Full Load

Distributed Generation

CEF Emergency Generator



Distributed Generation

CEF Emergency Generator



Distributed Generation

Capstone Microturbine CHP



Distributed Generation

Capstone Microturbine CHP

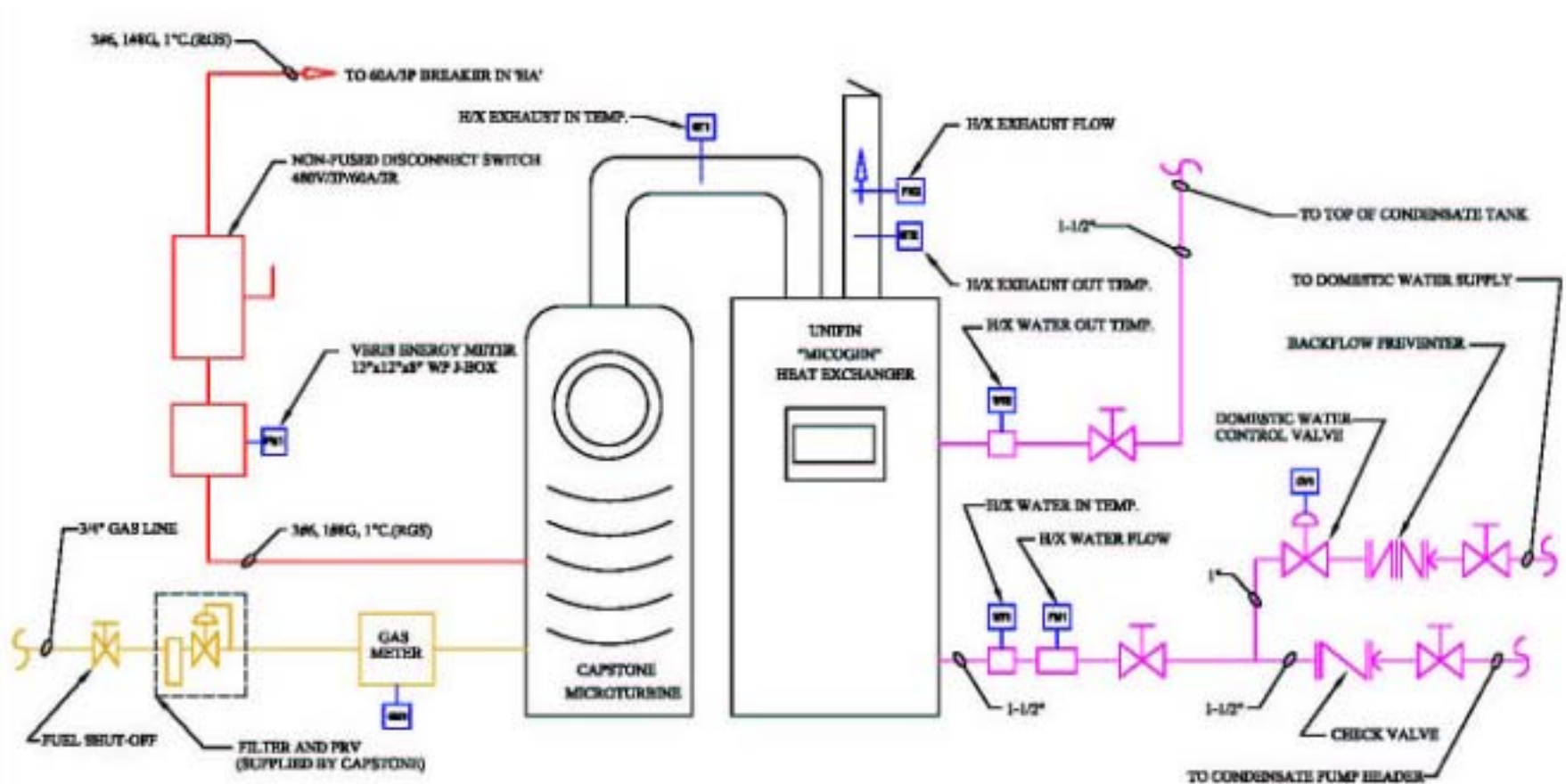


Distributed Generation

Capstone Microturbine CHP



Micro-Cogeneration



Future of DER

- Natural Gas is the Fuel of Choice for DER
 - » NG has increased in price an average of 14% per year over the last 10 years.
 - » Domestic production flat at ~ 19 TCF per year
 - » Canada, LNG provide ~ 5 TCF per
 - » EIA predicts US demand at 35 TCF by 2035
 - » New gas fired utility generators added at the rate of about 60,000 MW per year (avg. '02 & '03)
 - » 60,000 MW at 25% capacity factor = 815 BCF/year or about 4.3% of current domestic production

Questions?

